

# IMAGE CODING USING EMBEDDED ZEROTREE PATTERNS AND BITPLANES

## CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority from provisional patent application Serial No. 60/123,330, filed 03/08/99. The following copending application discloses related subject matter: serial no. 09/164,577, file 9/30/98, now Patent No. 6,956,973.

## BACKGROUND OF THE INVENTION

The invention relates to digital image compression and coding and decoding.

For encoding and compressing a single frame as in JPEG or an I frame in MPEG, Shapiro, Embedded Image Coding Using Zerotrees of Wavelet Coefficients, 41 IEEE Tr.Sig,Proc. 3445 (1993) provides a wavelet hierarchical subband decomposition which groups wavelet coefficients at different scales and predicts zero coefficients across scales. This provides a quantization and fully embedded bitstream in the sense that the bitstream of a lower bitrate is embedded in the bitstream of higher bitrates. Figures 2a-2c illustrate a wavelet transform decomposition.

Coding efficiency is, by definition, important to any image compression method. However, increasingly, the features or properties of a coding method play an increasing role in determining the usefulness of the method in practice. Scalability is a very important feature for any image coding method in many applications such as digital photography, Internet, image database, etc. There are many aspects of the scalability property, which can be summarized as follows:

Quality scalability: the bitstream can be parsed (without complicated processing) into sub-bitstream that can be decoded to have different quality reconstruction of the original image. An important case is progressive quality scalability, which means that the bitstream can be decoded progressively, with reconstructed images getting increasingly better with more and more bits received.

Resolution scalability: the bitstream can be parsed into sub-bitstream that represents different resolution of the original image. Progressive resolution scalability is a special case.